

## Claims

1. Illumination arrangement, in particular for a projection system or the like, comprising:

- 5       - a light source device (10) being adapted for generating and for emitting primary illumination light (L1) and
- a light collecting, integrating and redirecting device (20) being adapted for receiving at least a part of said primary illumination light (L1) from said light source device (10) and for redirecting said received primary illumination light (L1) so as to obtain redirected primary illumination light (RL1) and for outputting said redirected primary illumination light (RL1) or a derivative thereof as secondary illumination light (L2),
- 10       - wherein said light source device (10) at least comprises at least one solid state light source device (30),
- 15       - wherein said light collecting, integrating and redirecting device (20) comprises one light valve device (40) being adapted for receiving said redirected primary illumination light (RL1) and for outputting said secondary illumination light (L2) in a controllable manner, and
- 20       - wherein said light collecting, integrating and redirecting device (20) comprises at least one light integrating device (50) being adapted for directly receiving and for integrating at least a part of said primary illumination light (L1) generated by and emitted from at least one associated of said at least one solid state light source device (30) and for outputting said redirected primary illumination light (RL1) or a derivative thereof.
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2. Illumination arrangement according to claim 1, wherein each of said solid state light source devices (30) is or comprises a single or a plurality of solid state light sources (31, 32, 33).

30   3. Illumination arrangement according to claim 2, wherein each plurality of said solid state light sources (31, 32, 33) is or comprises an array (33) of solid state light sources (31, 32).

35   4. Illumination arrangement according to any one of the claims 2 or 3, wherein different kinds of solid state light sources (31, 32, 33) are involved, each of which in particular being adapted for generating and emitting radiation or light of distinct spectral ranges or colours and/or in particular being organized in distinct groups.

40   5. Illumination arrangement according to any one of the claims 2 to 4,

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wherein said solid state light source (31, 32, 33) is a single light emitting diode (31) or a multiplicity of light emitting diodes (31).

- 5 6. Illumination arrangement according to any one of the claims 2 to 5,  
wherein said solid state light source (31, 32, 33) is a single edge-emitting light emitting diode or a multiplicity of edge-emitting light emitting diodes.
- 10 7. Illumination arrangement according to any one of the claims 2 to 6,  
wherein said solid state light source (31, 32, 33) is a single vertical cavity surface emitting laser device (32) and/or a laser diode or a multiplicity of vertical cavity surface emitting laser devices (32) and/or of laser diodes.
- 15 8. Illumination arrangement according to any one of the claims 2 to 7,  
wherein said solid state light source (31, 32, 33) is a single resonant cavity light emitting diode or a multiplicity of resonant cavity light emitting laser diodes.
- 20 9. Illumination arrangement according to any one of the preceding claims,  
wherein said light integrating device (50) and said at least one associated solid state light source device (30) are disposed in closed spatial proximity or relationship to each other.
- 25 10. Illumination arrangement according to any one of the preceding claims,  
wherein said light integrating device (50) and said at least one associated solid state light source device (30) are disposed in direct mechanical contact to each other.
- 30 11. Illumination arrangement according to any one of the preceding claims,  
wherein said light integrating device (50) and said at least one associated solid state light source device (30) are disposed having a gap structure (G) between them, in particular an air gap (G) or an evacuated gap (G), the gap width of which in particular being small compared to the cross-section of the light integrating device (50) or the light source device (30).
- 35 12. Illumination arrangement according to any one of the preceding claims,
  - wherein said light integrating device (50) has a light incidence aperture (50I),
  - wherein said associated solid state light source device (30) has a light emitting aperture (30O, 30E), and
  - 40 - wherein said light emitting aperture (30O, 30E) is less than or equal to said light incidence aperture (50I).

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13. Illumination arrangement according to any one of the preceding claims,

- wherein said light valve device (40) has a light incidence or entrance aperture (40I),
- wherein said light integrating device (50) has a light output or exit aperture (50O, 50E), and
- wherein said light incidence or entrance aperture (40I) of said light valve device (40) is less than or equal to said light output or exit aperture (50O, 50E) of said light integrating device (50).

14. Illumination arrangement according to any one of the preceding claims,

wherein said light integrating device (50) is a light pipe, an integrator rod, or the like.

15. Illumination arrangement according to any one of the preceding claims,

wherein said light integrating device (50) is a solid rod, in particular made of an optical transparent material, of plastic, glass, or the like.

16. Illumination arrangement according to any one of the preceding claims,

wherein said light integrating device (50) is a hollow tube device having reflecting or mirrored inner walls (50s) or side faces (50s).

17. Illumination arrangement according to any one of the preceding claims,

wherein said light integrating device (50) has a square, rectangular, hexagonal, triangular, oval, or a circular cross-section.

18. Illumination arrangement according to any one of the preceding claims,

wherein said light integrating device (50) is or comprises a light mixing device (55), in particular a beam splitter device (55), a colour cube device (55), or the like.

19. Illumination arrangement according to claim 18,

wherein said light integrating device (50) comprises a plurality of light incidence or entrance apertures (50I) and at least one light output or exit aperture (50O, 50E).

20. Illumination arrangement according to any one of the preceding claims,

wherein a light coupling and/or guiding improving arrangement (50A) is provided which is adapted and/or arranged so as to improve coupling and/or guiding of said primary illumination light (L1) from said light source device (10) to and/or within said light collecting, integrating and re-directing

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device (20) and in particular to and/or within said light integrating device (50).

21. Illumination arrangement (40', 60', 100'), comprising:

- 5       - at least two light sources (41'-43', 61'-63') for generating first light beams, respectively,
- a light mixing device (44', 64', 65') for inputting said first light beams and combining them to a single second light beam, and
- a pyramidal light pipe (47', 66') which inputs said second light beam and
- 10       outputs a third light beam.

22. Illumination arrangement (40', 60', 100') according to claim 21,

wherein said illumination arrangement comprises three light sources (41'-43'), each of them generating a first light beam of one of the colors green, red and blue, respectively.

23. Illumination arrangement (40', 100') according to claim 21 or 22,

wherein said light mixing device is a color cube (44') showing at least two input surfaces for inputting one of said first light beams, respectively, and one output surface for outputting said second light beam.

24. Illumination arrangement (60') according to claim 21 or 22,

wherein said light mixing device is a dichroic filter (64', 65') or a combination of dichroic filters, each of said dichroic filters showing at least one input surface for inputting one of said first light beams, respectively, and one output surface.

25. Illumination arrangement (60') according to claim 24,

wherein said combination of dichroic filters comprises a first and a second dichroic filter (64', 65'), said first dichroic filter (64') showing two input surfaces for inputting two of said first light beams, and one output surface for outputting a first combined light beam, and said second dichroic filter (65') comprises one input surface for inputting one of said first light beams, one input surface for inputting said first combined light beam, and one output surface for outputting a second combined light beam.

26. Illumination arrangement (40', 60', 100') according to any one of the claims 23 to 25,

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wherein the lengths and the widths of output surfaces of said light sources are equal to or smaller than that of a respective input surface of said color cube (44')/the length and width of a respective input surface of said dichroic filters (64', 65').

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27. Illumination arrangement (40', 60', 100') according to claim 26,

wherein the lengths and the widths of an output surface of said color cube (44')/dichroic filter (65') which outputs said second light beam is substantially equal to the length and the width of an input surface of said pyramidal light pipe (47', 66') which inputs said second light beam.

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28. Illumination arrangement (40', 60', 100') according to any one of the preceding claims 21 to 27,

wherein between the light sources (41'-43', 61'-63') and the light mixing device (44', 64', 65') and/or between the light mixing device (44', 64', 65') and the pyramidal light pipe air gaps (G) are provided.

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29. Illumination arrangement (40', 60', 100') according to any one of the preceding claims 21 to 28,

wherein between each light source (41'-43', 61'-63', 101'-103') and the corresponding input surfaces of said color cube (44')/dichroic filters (64', 65') an additional pyramidal light pipe (109'-111') is located.

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30. Illumination arrangement (40', 60', 100') according to claim 29,

wherein the lengths and the widths of said output surfaces of said light sources (41'-43', 61'-63', 101'-103') are equal to or smaller than the lengths and the widths of input surfaces of said additional pyramidal light pipes (109'-111'), and the lengths and the widths of output surfaces of said additional pyramidal light pipes (109'-111') are substantially equal to said input surfaces of said color cube (44')/dichroic filters (64', 65').

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31. Illumination arrangement (40', 60', 100') according to claim 29 or 30,

wherein said input surfaces of said additional pyramidal light pipes (109'-111') and the light sources (101'-103') are in direct mechanical contact with each other.

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32. Illumination arrangement (40', 60', 100') according to any one of the claims 29 to 31,

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wherein between said additional pyramidal light pipes (109'-111') and the light mixing device air gaps (G) are provided.

33. Illumination arrangement (80'), comprising:

- 5       - at least two light sources (81'-83') for generating first light beams, respectively,
- a light mixing device (84') for inputting said first light beams and combining them to a single output light beam,
- wherein between each light source (81'-83') and the light mixing device (84') a
- 10       pyramidal light pipe (85'-87') is located.

34. Illumination arrangement (80') according to claim 33,

wherein input surfaces of said pyramidal light pipes (85'-87') and the light sources (81'-83') are in direct mechanical contact with each other.

35. Illumination arrangement (80') according to claim 33 or 34,

wherein between the pyramidal light pipes (85'-87') and the light mixing device (84') air gaps (G) are provided.

36. Illumination arrangement (40', 60', 100') according to any one of the preceding claims 21 to 35,

wherein said color cube (44') and/or said dichroic filter (64', 65') comprise at least two glass prisms (146', 147'), respectively.

37. Illumination arrangement (40', 60', 100') according to claim 36,

wherein between two of said glass prisms (146', 147') a glass plate (145') is provided, said glass plate (145') being coated with a transmissive/reflective film, wherein the surface dimensions of said glass plate (145') are bigger than the surface dimensions of surfaces of said prisms (146', 147') sandwiching said glass plate (145').

38. Illumination arrangement according to any one of the preceding claims 21 to 32,

wherein a light coupling and/or guiding improving arrangement (50A) is provided which is adapted and/or arranged so as to improve coupling and/or guiding of said primary illumination light (L1) from said light mixing device (44', 64', 65') to and/or within said light collecting, integrating and re-directing device (20) and in particular to and/or within said light integrating device (50).

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39. Illumination arrangement according to any one of the preceding claims 33 to 37,

wherein a light coupling and/or guiding improving arrangement (50A) is provided which is adapted and/or arranged so as to improve coupling and/or guiding of said primary illumination light (L1) from said light source device (81' - 83') to and/or within said light collecting, integrating and re-directing device (20) and in particular to and/or within said light integrating device (50).

40. Illumination arrangement, in particular for a projection system or the like, comprising:

- a light source device (10) being adapted for generating and for emitting primary illumination light (L1) and

- a light collecting, integrating and re-directing device (20) being adapted for receiving at least a part of said primary illumination light (L1) from said light source device (10) and for re-directing said received primary illumination light (L1), so as to obtain re-directed primary illumination light (RL1) and for outputting said re-directed primary illumination light (RL1) or a derivative thereof as secondary illumination light (L2),

- wherein said light collecting, integrating and re-directing device (20) comprise at least one light integrating device (50) being adapted for directly receiving and for integrating at least a part of said primary illumination light (L1) generated by and emitted from at least a part of said light source device (10) and for outputting said re-directed primary illumination light (RL1) or a derivative thereof,

- wherein a light coupling and/or guiding improving arrangement (50A) is provided which is adapted and/or arranged so as to improve coupling and/or guiding of said primary illumination light (L1) from said light mixing device (44', 64', 65') to and/or within said light collecting, integrating and re-directing device (20) and in particular to and/or within said light integrating device (50).

41. Illumination arrangement according to any one of the preceding claims,

- wherein said light integrating device (50) is or comprises a plain light pipe - in particular a solid integration rod - having a light incidence aperture (50I) and a side wall (50s),

- wherein said side wall (50s) of said light integrated device (50) is provided with a reflecting means (50m) as said light coupling and/or guiding improving arrangement (50a) or as a part thereof at its outer periphery at least in a neighborhood of said light incidence aperture (50I), and

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- wherein said reflecting means (50m) is adapted and/or arrangement so as to reflect light escaping from said light integrating device (50) through the side wall (50s) thereof back into said light integrating device (50).

5 42. Illumination arrangement according to any one of the preceding claims,

- wherein said light integrating device (50) is or comprises a plain light pipe - in particular a solid integration rod - having a light incidence aperture (50I),

10 - wherein said light incidence aperture (50I) of said light integrating device (50) is positioned in a neighborhood of a light exit aperture (30E) of said light source device (10) and/or of said light mixing devices (44', 64', 65') and

15 - wherein between said light incidence aperture (50I) of said light integrating device (50) and said light exit aperture (30E) of said light source device (10) and/or of said light mixing devices (44', 64', 65') refraction index matching means (50r) is or are provided, in particular filling a gap or a gap structure (G, G') between said light incidence aperture (50I) of said light integrating device (50) and said light exit aperture (30E) of said light source device (10) and/or of said light mixing devices (44', 64', 65').

20 43. Illumination arrangement according to claim 42,

wherein said refraction index matching means (50r) is a liquid, gel, and/or a glue.

25 44. Illumination arrangement according to any one of the preceding claims 42 or 43,

30 wherein said refraction index matching means (50r) has a refraction index which essentially coincides with the refraction index of the material of said light integration device (50) or with the refraction index of the material of the light source devices periphery ... interpolates between these refraction indices.

35 45. Illumination arrangement according to any one of the preceding claims,

- wherein said light integration device (50) is or comprises a hollow light pipe having a light incidence aperture (50I),

40 - wherein said light incidence aperture (50I) of said light integrating device (50) is positioned in a neighborhood of a light exit aperture (30E) of said light source device (10) and/or of said light mixing devices (44', 64', 65') and



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- wherein a second or end section in the neighborhood of said light incidence aperture (50l) and/or being terminated by said light incidence aperture (50l) is - in particular completely - filled with a plain light pipe section (50p), in particular for matching the respective refraction indices.